EFFECTS OF FERTILITY PRACTICE ON CHEAT COMPETITION IN SMALL GRAINS WITH NO-TILL AND CONVENTIONAL TILLAGE SYSTEMS

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CHAPTER I

INTRODUCTION

Weeds compete with cereal crops for moisture, plant nutrients, and light. Since these three basic requirements are seldom available in proportions adequate for maximum crop production, yields of cereal crops can only be maintained at a maximum where weed competition is eliminated (32). Competition from several *Bromus* species with winter wheat (*Triticum aestivum* L.) and perennial range grass has become a serious problem in the central plains of the United States. Peeper (34) reported estimated losses of $44 million in Oklahoma due to severe infestations of cheat (*Bromus secalinus* L.), and other weeds in winter wheat in 1977. Carter et al. (4) reported that, in addition to yield reductions, the presence of cheat seed in harvested grain reduces crop value. Other costs associated with cheat infestations include increased harvesting costs due to reduced harvesting speed and the costs of cleaning cheat seed from wheat (34).

Downy brome (*Bromus tectorum* L.) and Japanese chess (*Bromus japonicus* L.) are serious pests in both crop and rangelands, particularly in the western United States. These weeds begin growth in the fall or early spring and use moisture and nutrients that could be used more productively by perennial forage grasses (13). Chamberlin et al. (5) reported that livestock utilize downy brome and Japanese chess as forage for a short period in early spring, but these species are otherwise undesirable as livestock forage. In addition to reducing production of rangeland, downy brome produces long, sharp awns which can injure livestock through eye irritation or by lodging in the flesh of the animal's mouth. Due to its unusually dense stand and short life cycle, downy brome may also create a fire hazard throughout the summer months (15).

Possible methods of controlling Bromus species would include cultural practices to reduce competition of weeds or various types of chemical control. Factors which should be considered in the use of chemical control include selection of the proper herbicide, application rate and time of application. Preliminary studies indicate that certain fertilizer application methods might actually increase the production of Bromus species in wheat (40). This may have been due to placing the fertilizer where it is easily taken up by the cheat. Because of this, experiments were designed to evaluate the effect of various fertilizer placement methods on the infestation of Bromus species in wheat and to evaluate the feasibility of producing wheat or barley for forage and grain in the cheat infested perennial grass pasture using no-tillage seeding techniques.

CHAPTER II

LITERATURE REVIEW

Effects of Fertilizer Placement on Crop and Weed Species

Some investigators have demonstrated that application of mineral fertilizers can effectively reduce losses from weed competition. For example, Carter et al. (4), found that by establishing thick, uniform stands of wheat, seed production of cheat could be reduced by direct competition. Blackman and Templeman (2) reported that application of 52 kg/ha of nitrogen at seeding to barley (Hordeum volgare L.) plots infested with mustard (Brassica arvensis L.) increased barley yield to a level similar to that of weed-free barley with no added nitrogen fertilizer. However, Wells (49) stated that application of 50 kg/ha of nitrogen in the spring did not prevent wheat yield reduction from corn gromwell (Lithospermun arvense L.) competition, although wheat yields were increased. Similarly, Koch (28), found that in pot experiments spring oats and winter barley were not able to overcome the reduction of growth caused by wild mustard (Sinarpis arvensis L.) even when the weeds were removed at the beginning of barley tillering. A partial recovery of growth was observed when nitrogen was applied at 56 kg/ha.

Fertilizer placement is another management tool used in an effort to reduce weed competition in wheat. In 1958, Lynd et al. (29) reported that the most effective way to apply starter fertilizer material was to place the fertilizer in a row with the seed. Nakoneshny and Friesen (32) reported that response of wheat to 45 kg/ha on monoammonium phosphate (11-48-0) banded with the seed, became apparent as early as the two to three leaf stage of growth. At that time, wheat in the fertilized plots under both weedy and weed-free conditions was about 5 cm taller that wheat in corresponding unfertilized plots. Weeds found in these plots included wild oats (Avena fatua L.), wild mustard, wild buckwheat (Polygonum convolvulus L.), and hemp nettle (Galopsis tertrabit L.). They further stated that, on the average, wheat yield increases as a result of fertilizer treatment were of a similar magnitude to the increases resulting from weed removal. However, wheat yields invariably were highest where fertilizer application and weed removal were combined and lowest in control plots. Runyan (40) reported in 1980 on the effects of various fertilizing practices on cheat infestations in winter wheat. Treatments in his research included broadcast or banded aplications with the seed of 18-46-0 fertilizer at 59 and 123 kg/ha, both with and without spring broadcast application of granular 33-0-0 at 168 kg/ha, the spring ammonium nitrate treatment alone, and an unfertilized check. His data indicated that, when no spring topdressing was applied, there were no differences in dockage due to cheat between banded versus broadcast methods of starter fertilizer application. But when 33-0-0 was applied in the spring, dockage was higher where no fall fertilizer was applied or where fall fertilizer was broadcast, compared to banding fall fertilizer. Treatments also revealed a yield advantage from banding fertilizer with the seed over broadcasting fertilizer prior to seeding.

Small Grain Production in Overseeded Perennial Species

Squires et al. (43) reported in 1979 that interseeding, the process of drilling new plant species into existing sod, offered the potential of improving swards without incurring many of the problems of conventional reseeding. Typical problems of conventional reseeding include high cost, risk of failure and disturbance to swards, which can lead to severe erosion (50). In Oklahoma, interseeding to obtain grazing forage in March and April could be of substantial economic value because cattle must be removed from wheat fields to be harvested for grain before warm season grasses resume growth. Elder (8) reported in 1976 that in eastern Oklahoma, grazing from interseeded small grains is usually available in March or approximately 45 days before bermudagrass (Cynodon dactylon L.) resumes vigorous growth. He also reported that steers grazing on small grains interseeded into bermudagrass had an average gain of 0.9 kg per day per steer between March 15 and May 1. Decker et al. (7) of the University of Maryland increased total annual forage yields by interseeding wheat, rye (Secale cereale L.), and hairy vetch (Vicia villosa L.) into bemudagrass. Annual yields were increased from 4.5 kg/ha for bermudagrass alone, to 9.1 kg/ha for rye plus wheat interseeded into bermudagrass, to 14.5 kg/ha when a mixture of rye, wheat, and vetch (Vicia spp.) was interseeded into the bermudagrass. In field experiments at Tamworth, New South Wales, Australia, Spurway and Gleeson (42) found that annual forage yield was approximately doubled by interseeding barley into alfalfa (Medicago sativa L.), a warm seasonal perennial. Differences between the cereal species were small and both responded significantly to 50 kg/ha of N applied 4 weeks after sowing.

Production of grain by interseeding rangeland has also been investigated. Stonebridge et al. (46) found that over a 4-year period, grain yield of wheat interseeded into native pasture in western Australia was higher than or equal to conventionally prepared seed beds. They applied paraquat [1,1'-dimethyl-4,4'-bipyridinium ion] plus diquat [6,7-dihydrodiphrido[1,2-d:2',1'-C]pyrazimediium ion] (0.11 + 0.11 kg/ha) after seeding for weed control, and broadcast 56 kg/ha of N in the spring. Elder et al. (9) sod seeded 100 kg/ha of wheat into bermudagrass in October 20, 1967, in eastern Oklahoma on a Taloka soil with 224 kg/ha of 12-24-12 banded with the seed. On February 10, 1968, 100 kg/ha of nitrogen was broadcast. By April 10, 1976 kg/ha of dry forage was produced and grain yield was 2285 kg/ha. Elliott and Papendick (10) found that spring wheat seeded into killed blue grass (*Poa fendlerina* L.) sod in the Pacific Northwest produced yields equal to or better than spring wheat sown into conventionally tilled and prepared seedbeds. The bluegrass was killed with glyphosate [N-(phosphonomethyl) glycine].

Winter wheat would not work in this system because it was winter-killed and the bluegrass was not killed with an autumn glyphosate application. Roberson et al, (39) reported that he obtained normal yields of corn (*Zea mays* L.) seeded into glyphosate killed bahiagrass (*Paspalum notatum* L.) sod.

Downy Brome

Downy brome is a winter annual grass with slender clums from 10 to 60 cm tall, and flat leaves that are 3 to 5 mm wide. The inflorescence is a large, open, drooping panicle, with spikelets borne on very slender branches. The spikelets are 9 to 19 mm long, five-to eight-flowered, and average 30 per rachis. The florets are from 9 to 13 mm long, gradually tapering to a sharp point, and each has an untwisted awn from 9 to 16 mm long. In typical form, soft, fine hairs cover the leaves and florets (27).

Downy brome roots are fine, fibrous, and shallow compared to those of perennial grasses, according to Klemmedson and Smith (27). Spence (41) found that an average of seven main roots per plant penetrated the soil to an average depth of 30 cm. Hanson (22) and Tisdale (48) also indicated that downy brome has a shallow root system, seldom penetrating beyond 15 cm. In contrast, Hulbert (24) found that downy brome roots were more than 30 cm deep by mid November and penetrated a caliche layer whose upper limit was 1.2 to 1.5 m deep in loam soil by June 10. Hironaka (23) found that plants grown in an artificial soil profile contained in vertical, buried nylon cloth tubes, had roots 1 m deep. The root system showed little lateral branching until rapid top growth began in early April.

Downy brome was introduced into the arid and semi-arid western United States about 1900 and has become a major portion of the cover on grazing lands in that area (44). Hull and Hansen (25) reported that downy brome has some forage value in its immature stages; however, its palatability is somewhat lower than native perennial forage grasses. Forage production from downy brome fluctuates greatly with moisture conditions. Stewart and Hull (44) reported that in years of drought, forage yields dropped to less that 20% of the average as opposed to crested wheatgrass (Agropyron desertorum Fisch. ex Link Schult.) which produced 85% of its average forage. The growth of downy brome also depleted soil moisture before perennial range grasses resumed growth (11). Downy brome is a prolific seed producer and spreads rapidly. Seeds will germinate when conditions are favorable in fall, winter, or early spring. Hulbert (24) stated that large numbers of viable seeds persist from one year to the next in litter and soil, but germination of the seeds after that time is very low. In the past, chemical control of downy brome in rangeland was difficult because seed germination is not always simultaneous (33). Young et al. (53) reported in 1979 that downy brome seed production is density-dependent, which means that seed production tends to remain constant in the long run even though plant populations fluctuate from year to year. This characteristic has been attributed to greater seed production by low density populations than by high density populations (52). Stewart and Hull (44) also report that, even during an unusually dry year, when downy brome population is reduced, plants generally produced enough seed to provide a full stand the next year. They found that downy brome stands in southern Idaho rangeland vary from 1,000 to 15,000 plants/m^2 with an average of 6,150 plants/m^2. In 1944 and 1945, seed production averaged 535 kg/ha. The average number of seeds/g was 330. Thus, 535 kg/ha of seed reseeded the area with approximately 17,700 seeds/m^2 (177 million seeds/ha). It is little wonder therefore that downy brome is able to maintain its hold on infested areas.

Studies by Platt and Jackson (35) indicated that downy brome grows well on soils with low available N as well as on most fertile soils where competition has been eliminated. Stands of downy brome have developed following heavy grazing pressures on established native grass in Washington and Idaho (6,30), as well as in prime bottomland in sparse alfalfa stands (45).

Cheat and downy brome are the most troublesome annual grass weeds in winter wheat, alfalfa, and rangeland. Both are winter annuals that can germinate in the fall and produce seed the following spring, typically before wheat or alfalfa are harvested. Gigax (17) reported that metribuzin [4-amino-6-(1,1-dimethylethly)-3-(methylthio)-1,2,4-triazin-5(4H)-one] can control cheat and downy brome in winter wheat, but the chemical may be applied to only certain wheat varieties. Greer et al. (19) reported in 1980 that 'TAM W-101' was the only cultivar of wheat on which metribuzin could be used in Oklahoma. By 1982, metribuzin use was expanded to also include 'TAM 105' and 'Newton' cultivars (20). The cultivar 'Hawk' was added to this list in 1985 (18). Carmean and Russ (3) applied metribuzin at 0.28 kg/ha on November 18 and December 23, 1980, and at 0.42 kg/ha on March 1 and 20, 1981, to the five wheat cultivars, 'TAM W-101', 'Newton', 'TAM 105', 'Centurk 78', and 'Vona'. Plots were over seeded with cheat prior to wheat emergence. The best cheat control was obtained with 0.28 kg/ha applied November 18, 1980, which provided 94% control. The more effective spring treatment for cheat control was 0.56 kg/ha applied on March 1. Ramsey (36) investigated downy brome control in relation to weed and wheat growth stages. He obtained the best control with metribuzin at 0.56 kg/ha applied when wheat was at the 1 to 3 tiller stage. For acceptable crop tolerance, Greer et al. (20) suggested that fall treatments be applied after wheat has developed a minimum of three tillers and secondary roots at least 5 cm long, but before wheat is in the prostrate stage or winter dormancy. Spring treatments should be made after wheat has recovered from winter dormancy and resumed upright growth. Wheat should be fully tillered and should have developed secondary roots at least 5 cm long and before jointing. Rardon and Fay (38) applied metribuzin to winter wheat at various stages of growth in the laboratory with no weed competition. In their work, metribuzen at 0.43, 0.56, and 0.84 kg/ha applied when crown roots were underdeveloped reduced grain yields from 60 to 90%. Yield reductions of 5 to 25% occured when metribuzin was applied after the jointing stage of wheat.

Metribuzin has also been used for fallow period weed control in summer-fallowed winter wheat. Humburg (26) found that metribuzin at 5.6 kg/ha applied post-harvest demonstrated a high degree of control of weeds commonly found in wheat fields such as lambsquarter (*Chenopodium* spp.), Russian thistle, (*Salsola* *kali* L. var. tenuifolia tousch), downy brome, and volunteer wheat.

Fischer (16) reported that metribuzin at 0.42 and 0.56 kg/ha applied to wheat in the tillering stage of growth provided 75 to 100% cheat control and increased grain yield by 400 to 1400 kg/ha. The field studies were conducted at Perkins, Stillwater, and Lahoma, Oklahoma, on three varieties of winter wheat, 'TAM W-101', 'TAM 105', and 'Newton'. In his research, metribuzin applications reduced dockage from 26.4% with the most severe cheat infestation (500 to 700 plants/m^2) to as low as 1.5%. All rates of metribuzin applied at the jointing stage of growth reduced average grain yields in both cheat-free and cheat infested plots.

Metribuzin is also labeled for weed control in dormant, established alfalfa (47). Ramsey et al. (37) reported that metribuzin rates on alfalfa vary from 0.28 to 1.12 kg/ha depending on soil types and weed species to be controlled. Applications should be made in the early spring while alfalfa is still dormant. Alley and Lee (1) found that metribuzin at 1.12 kg/ha provided excellent downy brome control; however, herbicide injury reduced the alfalfa yield to that of the weedy check plots. Wilson and Hull (51) found similar yield reductions when metribuzin was applied at 1.12 kg/ha; however, when metribuzin was applied at 0.6 kg/ha there was no alfalfa yield reduction and excellent downy brome control was still obtained. Fenster (12) evaluated several herbicides in dormant alfalfa and found that metribuzin at 0.56 or 1.12 kg/ha provided 100% downy brome control. The lower rate did not injure the crop, but the higher rate reduced yield of the first and second cuttings. Wilson (52) evaluated fall-applied herbicides from 1978 through 1980 near Crawford, Nebraska, on dryland alfalfa. Metribuzin was applied at three rates, 0.3, 0.6 and 1.1 kg/ha. All three rates provided 100% control of downy brome and excellent control of kochia (Kochia scoparia L. Schrad.), tansy mustard (Descurainia pinnata Walt Britt.), and prickly lettuce (Lactuca serriola L.). Russian thistle control was obtained with 0.6 and 1.1 kg/ha metribuzin but only 69% control was obtained with 0.3 kg/ha. Visual alfalfa injury was 0, 3, and 28% with 0.3, 0.6, and 1.1 kg/ha of metribuzin, respectively. Injury was in the form of stem and leaf chlorosis and was evident only at the time of the first cutting.

Downy brome is also a serious pest in rangelands. Morrow et al. (31) stated that downy brome begins growth in the fall or early spring and reduces the animal carrying capacity of rangeland by utilizing much of the available winter and spring moisture before desirable forage grass begins growth in the spring. Fenester et al. (13) found that metribuzin, applied at 0.56 and 1.12 kg/ha in native grass pasture provided 95% downy brome control. Total forage yield was reduced by 10 to 13% in the early part of the growing season. By the end of the season, native grasses had fully recovered. Metribuzin at 0.37 kg/ha did not injure the native grasses but only controlled 68% of the downy brome. Morrow et al. (31) applied metribuzin to a silty clay loam, a loamy sand, and silt loam soil in Nebraska. They reported 95% control of downy brome on both the silty clay loam and loamy sand 20 months after application. Downy brome control for the silt loam soil was 100% 5 months after application but was reduced to 40% 17 months after application. However, total forage yields were increased for all three soils over the untreated checks. They concluded that differences in metribuzin effectiveness were related to soil texture.

CHAPTER III

METHODS AND MATERIALS

Effect of Fertilizer Placement on Crop and Weed Species

A field experiment was conducted from the fall of 1980 to the summer of 1982 on a Carey silt loam soil (Typic Argiustolls) with a slope of 1 to 3 percent in Custer County, Oklahoma, to evaluate the effect of fertilizer placement on cheat competition with wheat. The experiment was arranged in a split plot design replicated three times. The two main plot treatments were foraged or non-foraged and the sub-plots were fertilizer treatments (Table I). The foraged treatments were harvested with a flail type mower prior to the jointing stage of wheat to simulate grazing.

In August, 1980, prior to fertilizer application, the soil contained 44 kg/ha of NO_3-N, a P index of 104 kg/ha and a K index of 579 kg/ha the 1 to 15 cm soil depth. Soil testing procedures used are outlined in Oklahoma State University Extension Fact Sheet No. 2901 (21). The NO_3-N analysis included adding 30 ml of calcium sulfate ($CaSO_4$) solution to 10 g of soil and shaking for one hour. At this point, the electrodes of an Orion Research Ionalyzer are placed directly into the soil solution mixture to measure the NO_3-N.

To obtain a soil P index on soils, the Oklahoma State University Soil Testing Laboratory used a 1:20 soil to solution modified

TABLE I

SOURCES, RATES, APPLICATION METHODS, AND TIMING OF FERTILIZER TREATMENTS

Treatment	Source[1]	Method[2]	Rate (kg/ha) N	Rate (kg/ha) P_2O_5	Timing
1	AA	INJ	111	0	Fall
2	DAP	BD	10	26	Fall
3	DAP	BD	20	52	Fall
4	DAP	BD	10	26	Fall
	AN	BC	55	0	Spring
5	DAP	BD	20	52	Fall
	AN	BC	55	0	Spring
6	DAP	BC	10	26	Fall
7	DAP	BC	20	52	Fall
8	DAP	BC	10	26	Fall
	AN	BC	55	0	Spring
9	DAP	BC	20	52	Fall
	AN	BC	55	0	Spring
10	AN	BC	55	0	Spring
11	AN	BC	111	0	Spring
12	---	CHECK	0	0	------

1 Anhydrous ammonia (AA), diammonium phosphate (DAP), ammonium nitrate (AN)

2 Injected (INJ), band (BD), broadcast (BC). Broadcast DAP applications were pre-plant incorporated.

Bray/Kurtz extraction solution. After shaking for 5 minutes, the mixture was filtered through Whatman #2 filter paper. Five ml of extract was mixed with 5 ml of ascorbic acid ($C_6H_8O_6$) color complex, 10 ml of boric acid (H_3BO_3) solution, and allowed to stand for 45 minutes then read at 840 nm with a Brinkmann colorimeter.

To analyze soil for K, 10 ml of ammonium acetate (NH_4OCOCH_3) solution was added to 2 g of soil. The mixture was filtered through Whatman #2 filter paper and the extract was analyzed by atomic absorption.

The anhydrous ammonia treatment (AA) (82-0-0) was applied on August 17, 1980 at the rate of 128 kg/ha of N. Application was made with a three section stubble mulch plow with an anhydrous ammonia applicator. The applicator consisted of a control valve with two outlets per section, one 6.35 mm I.D. pipe was mounted under each wing with 3.17 mm diameter holes drilled every 38 cm and 9.5 mm diameter rubber hose connecting the control valve to the discharge pipes.

After application of the anhydrous ammonia, all plots were over seeded with cheat seed and deammonium phosphate (DAP) (18-46-0) (oxide form) was broadcast, where appropriate. Overseeding with cheat provided a thick, even distribution of cheat plants. The area was then disked once to a depth of 15 cm. Winter wheat, cv. 'TAM W-101', was seeded at 67.2 kg/ha with a John Deere 8350 single disk drill with a fertilizer attachment on September 25, 1980. Broadcast fertilizer applications were made with the same John Deere 8350 drill by allowing the fertilizer to fall freely from fertilizer tubes approximately 23 cm above the ground. Broadcast applications of ammonium nitrate (AN) (33-0-0) were made on February 26, 1981. Forage yields were determined by harvesting a 1 m by 3.05 m area from the foraged plots on March 10, 1981, with a flail type forage harvester. Samples were placed in brown paper bags, and dried for 48 hours at 66 C. Dry forage yields were calculated based on moisture content of the samples. Grain yields were determined by harvesting a 1.5 m by 7.6 m area from each plot on June 22, 1981, with a small plot combine. Samples were sacked in the field then later weighed and cleaned with a small commercial type seed cleaner to determine dockage.

In the fall of 1981, the experiment was repeated on the same plots with the following differences in procedure. Plots received 119 kg/ha of N as AA on August 23, 1981. Plots were sown on November 19, 1981, and the spring broadcast treatment of AN was applied on Feburary 19, 1982. Due to the lack of fall growth caused by the late planting date, forage harvest was not feasible. The foraged and non-foraged plots were pooled and the experiment was considered a randomized block design replicated six times. All data were subject to analysis of variance and treatment means were separated using nonorthogonal single degree of freedom contrasts that were preplanned and meaningful. On July 1, 1982, grain yields were determined by harvesting a 1.5 m by 7.6 m area from each plot. Samples were sacked in the field and dockage was determined as previously described.

Small Grain Production on Interseeded Native Species

Two experiments were established in the fall of 1980 to determine the feasibility of interseeding wheat and barley into native grass for forage and grain production. Both locations were in areas of established native grass. One was on a St. Paul silt loam soil (1 to 3 percent slope) and the other on the Woodward-Quinlan Complex soil (3 to 5 percent slope) in Custer County, Oklahoma. The experimental design was a randomized complete block replicated four times. Treatments were comprised of species (wheat, barley, or native grass) and fertility (no fertilizer or band application of DAP at 10-26-0 kg/ha in the fall followed by a broadcast application of AN at 55-0-0 kg/ha in the spring). Surface soil from the St. Paul silt loam area, analyzed prior to establishment of the experiment, contained 21.3 kg/ha of NO_3-N, a P index of 69 kg/ha and a K index of 743 kg/ha. The Woodward-Quinlan complex soil contained 11 kg/ha of NO_3-N, a P index of 80 kg/ha and a K index of 750 kg/ha in the top 15 cm. Cattle were allowed to graze both areas until planting.

A modified John Deere model LZ 1010 hoe-type drill with a fertilizer attachment was used for seeding and band application of fertilizer. Modifications of the drill included rolling coulters mounted in front of the planting shoe and extra weight added to aid penetration of the coulters. The planting shoe was a special no-tillage shoe with a narrow replaceable planting tip. Damage to the sod was minimized by the slicing action of the rolling coulters and narrow planting tip. On September 25, 1980, winter wheat (cv. Triumph - 64) and barley (cv. Post) were sown at 67.2 kg/ha and 84 kg/ha, respectively. Spring fertilizer applications were made with a John Deere 8350 drill with a fertilizer attachment on March 12. The fertilizer was allowed to drop freely from fertilizer tubes approximately 23 cm above the ground. Forage yields were determined by clipping 0.3 m by 0.3 m area from each plot on May 20, 1981. Forage samples were sacked in the field, then dried for 48 hours at 66 C. Dried forage samples were weighed and yield was recorded. Grain yields were determined by harvesting a 1.5 m by 12.2 m area from each plot on June 22, 1981. Grain samples were sacked in the field, weighed, cleaned with a small commercial seed cleaner, and reweighed to determine dockage.

In the fall of 1981, the procedure as described above was repeated except that 'TAM W-101' was substituted for 'Triumph - 64' so that metribuzin could be applied for Bromus spp. control and the data were analyzed as a split plot design. Plots were sown on November 19, 1981. The fertilized treatments received a broadcast application of AN at 168 kg/ha of 55-0-0 kg/ha on February 19, 1982. Forage yields were determined by hand plucking the forage from a 0.3 m by 0.3 m area on March 15, 1982. Samples were sacked in the field, then dried in an oven for 48 hours at 66 C. Total dry matter yield of the plots were calculated based on dry matter of the sample. On March 15, 1982, half of each plot was treated with metribuzin at 0.42 kg/ha. The application was made with a centrifugal pump sprayer with a 6 nozzle boom equipped with 11005 flat fan nozzle tips spaced 50.8 cm apart. Carrier volume was 140 l/ha. Boom pressure was 22.5 g/mm. On July 1, 1982, grain yields were determined by harvesting two 1.5 m by 12.2 m areas from each plot. Samples were sacked in the field, weighed, cleaned with a small commercial seed cleaner, and reweighed. Clean grain yield and dockage were recorded.

CHAPTER IV

RESULTS AND DISCUSSION

Effects of Fertilizer Placement on Crop and Weed Species

In 1981, the addition of DAP banded (BD) at the high (H) (20-52-0) rate increased yield of dry forage over all other treatment comparisons that were made (Tables II and III). There were no significant differences in grain yield of the foraged vs non-foraged treatments, therefore, plot responses were pooled and the exerpiment was analyzed as a randomized block design with six replications. Before and after cleaning wheat yields were increased over the check when yields were averaged over all fertilizer treatments.

When no DAP was applied, the application of AN(L) did not increase yield or dockage. However, application of AN(H) alone increased yield compared to AN(L) alone or the unfertilized check and decreased dockage compared to AN(L). The effect of AN(L) on dockage may also be evident in two treatments that contained DAP. Both DAP-BD-H and DAP-BC-L had higher yields and less dockage than the unfertilized check. However, when AN(L) was added to these treatments in the spring, dockage increased to where it was no longer significantly lower than the check.

Interestingly, the preplant aplication of AA decreased dockage and increased test weight compared to the unfertilized check, but did not increase grain yield. Both of the higher rates of nitrogen (AA or

TABLE II

EFFECT OF FERTILITY PRACTICE ON GRAIN AND FORAGE PRODUCTION OF CHEAT INFESTED WHEAT

Source and Method[1]	Rate (kg/ha) N	Rate (kg/ha) P_2O_5	1981 Dry Forage Yield (kg/ha)	1981 Wheat Yield Before Cleaning (kg/ha)	1981 Wheat Yield After Cleaning (kg/ha)	1981 Dockage %	1981 After Cleaning Test Wt. (kg/hl)	1982 Wheat Yield Before Cleaning (kg/ha)	1982 Wheat Yield After Cleaning (kg/ha)	1982 Dockage %	1982 After Cleaning Test Wt. (kg/hl)
AA[2]	119	0	1114	1337	1287	3.6	74.4	1531	1015	31.8	64.6
DAP-BD-L	10	26	1164	1340	1269	5.6	73.5	1152	611	47.6	65.5
DAP-BD-H	20	52	2000	1462	1405	4.1	74.2	1276	809	37.5	67.3
DAP-BD-L + AN-L	65	26	1420	1447	1376	4.8	74.2	1192	650	45.6	64.3
DAP-BD-H + AN-L	75	52	1442	1554	1476	5.0	74.2	1268	770	38.9	64.1
DAP-BC-L	10	26	1279	1492	1433	4.0	73.9	1481	889	40.6	66.9
DAP-BC-H	20	52	1305	1317	1251	5.2	73.5	1315	809	39.2	67.3
DAP-BC-L + AN-L	65	26	1420	1623	1544	4.9	73.9	1285	522	59.1	63.5
DAP-BC-H + AN-L	75	52	1234	1486	1418	4.9	74.2	1299	699	45.7	64.7
AN-L	55	0	1651	1182	1092	7.4	73.1	1159	544	53.4	63.5
AN-H	111	0	1323	1496	1422	4.9	73.5	1287	542	56.1	61.5
Check	0	0	1513	1234	1159	6.4	73.3	1147	555	53.2	65.5

1 Anhydrous ammonia (AA), diammonium phosphate (DAP), ammonium nitrate (AN) were used as sources. Methods of P application were banded (BD), and broadcast (BC). Fall BC applications were disked in preplant. Rates of application were high (H), and low (L).

2 AA applied on August 17, 1980 at the rate of 128 kg/ha of N, and on August 23, 1981 at the rate of 119 kg/ha of N, respectively.

TABLE III

ANALYSIS OF VARIANCE AND NONORTHOGONAL SINGLE DEGREE OF FREEDOM CONTRAST COMPARISONS OF FERTILIZER APPLICATION METHOD EFFECTS ON GRAIN YIELD AND FORAGE PRODUCTION

		F Values				
		1981				
		Dry	Wheat Yield			After
Source and Method and Rate+	df	Forage Yield (kg/ha)	Before Cleaning (kg/ha)	After Cleaning (kg/ha)	Dockage %	Cleaning Test Wt. (kg/hl)
Treatments	11	0.88	1.85	1.98**	1.85	1.50
Contrasts						
Check vs rest	1	0.19	3.76*	4.10**	3.17*	165.75****
DAP-BD-L vs DAP-BC-L	1	0.10	1.22	1.49	2.08	0.81
DAP-BD-H vs DAP-BC-H	1	3.80*	1.11	1.31	0.99	1.71
DAP-BD-L + AN-L vs DAP-BC-L + AN-L	1	0.00	1.64	1.57	0.02	0.17
DAP-BD-H+AN-L vs DAP-BC-H+AN-L	1	0.34	0.25	0.19	0.01	0.00
AA vs AN-L	1	1.36	1.28	2.11	12.50****	7.34
AA vs AN-H	1	0.14	1.34	1.01	1.42	3.28*
AA vs Check	1	1.08	0.56	0.91	6.77**	5.11**
AN-L vs Check	1	0.15	0.14	0.25	0.81	0.20
AN-L vs AN-H	1	0.56	5.23**	6.04**	5.50**	0.81
AN-H vs check	1	0.19	3.64*	3.84*	2.08	0.20
DAP-BD-L vs DAP-BD-H	1	5.50**	0.79	1.03	1.87	1.17
DAP-BC-L + AN-L vs DAP-BC-H + AN-L	1	0.22	0.99	0.88	0.00	0.17
DAP-BD-H vs DAP-BD-H + AN-L	1	2.45	0.45	0.28	0.66	0.00
DAP-BC-L vs DAP-BC-L + AN-L	1	0.11	0.91	0.68	0.66	0.00
DAP-BC-H vs DAP-BC-H + AN-L	1	0.03	1.52	1.55	0.08	1.71
DAP-BD-L vs Check	1	0.96	0.59	0.67	0.55	0.20
DAP-BD-H vs Check	1	1.87	2.76	3.24*	4.46**	3.08*
DAP-BD-L + AN-L vs Check	1	0.06	2.41	2.61	2.32	3.08*
DAP-BD-H + AN-L vs Check	1	0.04	5.43**	5.58**	1.69	3.08*
DAP-BC-L vs Check	1	0.43	3.53*	4.17**	4.78**	1.81
DAP-BC-H vs Check	1	0.34	0.37	0.47	1.25	0.20
DAP-BC-L + AN-L vs Check	1	0.79	8.03****	8.23***	1.89	1.81
DAP-BC-H + AN-L vs Check	1	0.61	3.37*	3.72*	0.56	3.08*
Error Mean Square	55	254101	56517	54045	3.47	0.70
CV, %	--	35.80	16.80	17.30	36.70	1.1

TABLE III (CONTINUED)

Source and Method and Rate+	F Values — 1982 — Wheat Yield — Before Cleaning (kg/ha)	After Cleaning (kg/ha)	Dockage %	After Cleaning Test Wt. kg/hl)
Treatments	1.42	3.88****	3.34****	3.90****
<u>Contrasts</u>				
Check vs rest	1.94	3.61*	2.69	20.60****
DAP-BD-L vs DAP-BC-L	5.26**	5.98**	1.35	1.14
DAP-BD-H vs DAP-BC-H	0.07	0.00	0.08	0.00
DAP-BD-L + AN-L vs DAP-BC-L + AN-L	0.41	1.27	4.88**	0.87
DAP-BD-H+AN-L vs DAP-BC-H+AN-L	0.05	0.39	1.22	0.29
AA vs AN-L	6.72****	17.17****	12.89****	0.87
AA vs AN-H	2.89*	17.31****	16.07****	13.02****
AA vs Check	7.15***	16.37****	12.50****	0.44
AN-L vs Check	0.00	0.00	0.00	2.57
AN-L vs AN-H	0.80	0.00	0.17	2.57
AN-H vs check	0.95	0.01	0.22	10.28****
DAP-BD-L vs DAP-BD-H	0.74	3.02*	2.74	2.16
DAP-BC-L + AN-L vs DAP-BC-H + AN-L	0.00	2.42	4.88**	1.44
DAP-BD-H vs DAP-BD-H + AN-L	0.00	0.12	0.06	7.14***
DAP-BC-L vs DAP-BC-L + AN-L	1.86	10.42****	9.40****	8.64***
DAP-BC-H vs DAP-BC-H + AN-L	0.01	2.93	1.16	4.57***
DAP-BD-L vs Check	0.00	0.24	0.88	0.00
DAP-BD-H vs Check	0.81	4.99**	6.74**	2.16
DAP-BD-L + AN-L vs Check	0.09	0.69	1.54	0.87
DAP-BD-H + AN-L vs Check	0.71	3.57*	5.51**	1.44
DAP-BC-L vs Check	5.42**	8.63****	4.41**	1.14
DAP-BC-H vs Check	1.37	4.99**	5.38**	2.16
DAP-BC-L + AN-L vs Check	0.92	0.08	0.93	3.49*
DAP-BC-H + AN-L vs Check	1.12	1.60	1.55	0.44
Error Mean Square	61789	38769	109	4.67
CV, %	19.40	28.10	22.80	3.30

*, **, ***, **** Indicates significance at P = 0.10, 0.05, 0.01, and 0.005 level of probability, respectively.

+ Anhydrous ammonia (AA), ammonium nitrate (AN), and diammonium phosphate (DAP) were used as sources. Methods of application were band (BD) and broadcast (BC). Application rates were high (H) and low (L). DAP high and low rates are 10-26-0, and 20-52-0 kg/ha oxidized forms, respectively. AN high and low rates are 55-0-0 and 111-0-0 kg/ha, respectively.

AN-H) decreased dockage compared to application of AN(L) only. The only difference between AA and AN-H was that the after cleaning test weight was higher with AA than AN(H).

Comparisons between methods and rates of DAP indicated that although two of four DAP treatments increased yield and reduced dockage compared to the check there was no difference in dockage or yield directly attributable to method of application.

In 1982, as in 1981, application of AN(L) alone had no effect on yield, dockage, or test weight. AN(H) alone increased test weight in 1982, whereas in 1981 it increased yield and did not affect test weight. Among the nitrogen only treatments, in 1982, AA increased yield and reduced dockage compared to AN(L) and the unfertilized check. The effect on dockage was similar to that of the previous year.

Unlike the results in 1981, in 1982 the DAP applications had an effect on dockage due to cheat. Compared to the check, three of the four DAP treatments, with no AN added, reduced dockage. A method effect was not apparent with DAP alone but was when AN(L) was topdressed in the spring. In both DAP-BC treatments, application of AN(L) increased dockage to where it was no longer less than the check. However, when DAP was banded at the high rate (DAP-BD-H) and AN(L) was applied, dockage remained over 14% less than the unfertilized check. The results obtained seem to support observations by Runyan (40) that applications of AN in the spring can increase dockage due to cheat, particularly when DAP is broadcast in the fall. Both the data herein and that of Runyan (40), demonstrates that when DAP is banded with the seed, spring applications of AN do not increase dockage due to cheat.

Small Grain Production on Interseeded Native Grass Species

Forage Production

Data from the interseeding experiments indicates that addition of fertilizer, banded and topdressed in the spring, did increase forage production. In 1981 and 1982, at both the Woodward-Quinlan Complex (Typic Ustochrepts) and St. Paul silt loam (Pachic Argiustolls) sites, forage production, averaged across species, was increased by fertilizer treatments (Tables IV and V). Total forage yield was higher for treatments where wheat was interseeded compared to treatments interseeded with barley or with no interseeding in 1981 at the St. Paul Silt Loam site. There was also interaction between species and fertilizer treatments at the same site in 1981. The wheat responded more to the fertilizer than did the barley. Forage production in 1982 was lower because of the later seeding date and earlier forage harvest.

Grain Production 1981

At the Woodward-Quinlan Complex site in 1981, grain yields were higher and dockage was lower for interseeded wheat than for interseeded barley plots (Table VI). Fertilizer treatments significantly increased yield and reduced dockage for treatment means. There was no intereaction between fertilizer treatments and species treatments. At the St. Paul silt loam site, grain yield was increased and dockage was decreased when fertilizer was applied. Wheat plots had higher grain yield than did the barley (Table VII). Dockage was also less for the interseeded wheat than for the interseeded barley. The data also

TABLE IV

EFFECT OF SPECIES AND FERTILIZER ON FORAGE PRODUCTION ON WOODWARD QUINLAN SOIL (NO-TILL)

CROP YEAR	Variety	Rate (kg/ha) N	Rate (kg/ha) P_2O_5	SPECIES Wheat	Barley	Unseeded	Means
				Yield (kg/ha)			
1981	'Triumph 64'						
		0	0	1721	1880	1600	1754
		65	26	2893	2966	2270	2710
		Mean		2307	2423	1965	----
		CV = 21%					
1982	'Tam W-101'						
		0	0	136	154	88	126
		65	26	381	336	428	382
		Mean		258	245	258	---
		CV = 49%					

LSD .05 for comparing fertilizer treatment means averaged across species in 1981 = 417.

LSD .05 for comparing fertilizer treatment means averaged across species in 1982 = 74.

TABLE V

EFFECT OF SPECIES AND FERTILIZER ON FORAGE PRODUCTION ON ST. PAUL SILT LOAM SOIL (NO-TILL)

CROP YEAR	Variety	Rate (kg/ha) N	Rate (kg/ha) P_2O_5	SPECIES Wheat	SPECIES Barley	SPECIES Unseeded	Means
				Yield (kg/ha)			
1981	'Triumph-64'						
		0	0	1782	1758	1880	1806
		65	26	4052	2820	2685	3186
		Means		2917	2289	2282	---
		CV = 15%					
1982	'Tam W-101'						
		0	0	302	198	168	223
		65	26	485	422	595	500
		Mean		393	310	381	---
		CV = 45%					

LSD .05 for comparing any two treatment means in 1981 = 572.
LSD .05 for comparing fertilizer treatment means averaged across species in 1981 = 330.
LSD .05 for comparing species treatment means averaged across fertilizer in 1981 = 404.
LSD .05 for comparing fertilizer treatment means averaged across species in 1982 = 95.

TABLE VI

EFFECT OF SPECIES AND FERTILIZER TREATMENT ON ON GRAIN YIELD AND DOCKAGE (WOODWARD QUINLAN COMPLEX, 1981) (NO-TILL)

Fertilizer Treatments (kg/ha) N	P_2O_5	SPECIES ---- Yield (kg/ha) ---- Wheat	Barley	Means	----- Dockage (%) ----- Wheat	Barley	Means
0	0	69	51	60	55	76	66
65	26	330	105	217	25	58	41
Means		(199)	(78)	---	[40]	[67]	--

LSD .05 for comparing yield means, in ( ), of species averaged across fertilizer treatments = 131.
LSD .05 for comparing dockage means in [ ], of species averaged across fertilizer treatments = 25.
CV for yield = 83%
CV for dockage = 42%

TABLE VII

EFFECTS OF SPECIES AND FERTILIZER TREATMENTS ON GRAIN YIELD AND DOCKAGE (ST. PAUL SILT LOAM, 1981) (NO-TILL)

Fertilizer Treatments (kg/ha)		SPECIES					
		---- Yield (kg/ha) ----			----- Dockage (%) -----		
N	P_2O_5	Wheat	Barley	Means	Wheat	Barley	Means
0	0	142	5	(74)	24	90	[57]
65	26	350	24	(187)	13	73	[43]
Means		(246)	(15)	---	[19]	[81]	--

LSD .05 for comparing yield means, in ( ), = 37.
LSD .05 for comparing dockage means, in [ ], = 7.
LSD .05 for comparing fertilizer treatments by species interaction for yield = 52.
CV for yield = 20%
CV for dockage = 9%

indicated that there was fertilizer by species interaction in grain yield but not for dockage. This observation indicates that wheat is more responsive to fertilizer treatment than is barley.

Grain Production 1982

Bromus species were so dense in 1982 that little crop grain was produced. However, grain harvest data from the Woodward-Quinlan Complex in 1982 indicates that grain yield was increased with fertilizer treatments and that yield of wheat was more than double that of barley (Table VIII). Metribuzin treatment had no significant effect on grain yield; however, there was a slight reduction in dockage due to metribuzin treatment (Table IX). Plots that were interseeded with wheat had less dockage than plots interseed with barley. There was an interaction between metribuzin and fertilizer treatments in yield and percent dockage at the St. Paul silt loam site in 1982 (Table X). Grain yield and dockage were not significantly affected by metribuzin treatment when plots received no fertilizer. However, grain yields were increased and percent dockage was reduced with addition of both metribuzin and fertilizer treatments. When calculating means of metribuzin treatments across fertilizer treatments, grain yield was increased and dockage was reduced with application of metribuzin. Grain yield was increased and dockage was reduced with fertilizer application when means were calculated across metribuzin treatments.

TABLE VIII

EFFECT OF SPECIES AND FERTILIZER ON GRAIN YIELD AND DOCKAGE (WOODWARD-QUINLAN COMPLEX, 1982) (NO-TILL)

Fertilizer Treatments (kg/ha)		SPECIES					
		Yield (kg/ha)			Dockage (%)		
N	P_2O_5	Wheat	Barley	Means	Wheat	Barley	Means
0	0	16	5	(11)	80	95	87
65	26	49	26	(37)	79	90	84
Means		(33)	(16)	---	[79]	[92]	--

LSD .05 for comparing yield means, in ( ), = 16.
LSD .05 for comparing dockage means in [ ], = 6.
CV for yield = 132%
CV for dockage = 13%

TABLE IX

EFFECT OF SPECIES AND HERBICIDE TREATMENT ON GRAIN YIELD AND DOCKAGE (WOODWARD-QUINLAN COMPLEX, 1982) (NO-TILL)

Metribuzin Treatment (kg/ha)	SPECIES					
	Yield (kg/ha)			Dockage (%)		
	Wheat	Barley	Means	Wheat	Barley	Means
-0-	28	11	19	85	95	[90]
0.42	38	20	29	74	89	[82]
Means	(33)	(15)	---	[79]	[92]	--

LSD .05 for comparing yield means, in ( ), = 16.
LSD .05 for comparing dockage means, in [ ], = 6.
CV for yield = 132%
CV for dockage = 13%

TABLE X

EFFECT OF HERBICIDES AND FERTILIZER TREATMENT ON GRAIN YIELD AND DOCKAGE (ST. PAUL SILT LOAM, 1982) (NO TILL)

Metribuzin Treatment (kg/ha)	Fertilizer Treatment					
	---- Yield (kg/ha) ----			----- Dockage (%) -----		
	None	Fertilized	Means	None	Fertilized	Means
-0-	4	13	(8)	97	95	[96]
0.42	6	32	(19)	95	87	[91]
Means	(5)	(22)	---	[96]	[91]	--

LSD .05 for comparing yield means, in ( ), = 4.
LSD .05 for comparing dockage means, in [ ], = 2.
LSD .05 for comparing herbicide by fertilizer treatment interaction for yield = 7.
LSD .05 for comparing herbicide by fertilizer treatment interaction for dockage = 3.
CV for yield = 64%
CV for dockage = 4%

CHAPTER V

SUMMARY

Three field experiments were conducted for two years to investigate the influence of selected fertilizer application methods on the severity of cheat infestation in winter wheat and to determine the feasibility of producing small grains on Bromus spp. infested native grass pasture using no-tillage seeding techniques.

In both 1981 and 1982, either banding 112 kg/ha of DAP at seeding or braodcasting 56 kg/ha of DAP before seeding increased yield and decreased dockage due to cheat. In 1982 only, broadcasting and disking in 112 kg/ha of DAP prior to seeding increased yield and decreased dockage.

In both 1981 and 1982, injecting anhydrous ammonia prior to seeding reduced dockage due to cheat, compared to the unfertilized check. The anhydrous ammonia treatment also had less dockage both years than the treatments with ammonium nitrate applied in the spring at 168 kg/ha. The data indicates that, in general, deeper placement of fertilizer favors wheat over cheat. In contrast, spring surface applications of nitrogen in cheat infested fields tend to increase cheat problems without increasing wheat yield.

Data from the interseeding experiments indicate that fertilizer treatments increased forage production in both 1981 and 1982 at both the Woodward-Quinlan Complex at St. Paul silt loam sites. Total forage yield was higher for treatments where wheat was interseeded compared to treatments interseeded with barley or no interseeding.

In 1981 and 1982 at both sites, grain yields were higher and dockage was less for interseeded wheat when compared to interseeded barley. Fertilizer treatments increased yield and reduced dockage over non-fertilized treatments.

In 1982, at the St. Paul silt loam site there was an interaction between metribuzin and fertilizer treatments. Grain yield and dockage were not effected by metribuzin treatments when plots received no fertilizer. However, grain yield was increased and and dockage was decreased with spray treatments when plots were fertilized. Inability to obtain Bromus spp. control undoubtedly reduced yield at both locations both years.

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APPENDIX

RAINFALL DATA - CLINTON, OKLAHOMA
(JULY 1, 1980 - JUNE 30, 1982)

Date	Millimeters	Date	Millimeters
July 24, 1980	.25	Apr. 14	12.19
Aug. 21	.25	Apr. 16	2.43
Sept. 1	1.77	Apr. 18	.50
Sept. 2	.76	Apr. 19	13.21
Sept. 10	16.25	Apr. 21	.50
Sept. 27	11.43	Apr. 30	13.97
Sept. 28	11.17	May 2	21.84
Sept. 29	.50	May 5	3.81
Oct. 15	10.41	May 8	.50
Oct. 16	26.16	May 9	4.06
Oct. 17	.25	May 10	2.54
Oct. 27	4.82	May 16	3.30
Nov. 14	13.46	May 17	7.62
Nov. 15	1.02	May 23	6.60
Nov. 17	4.06	May 29	6.60
Nov. 18	.50	June 1	.50
Nov. 23	.76	June 2	26.41
Nov. 26	2.79	June 3	13.20
Dec. 8	30.73	June 4	9.90
Dec. 9	2.03	June 6	1.77
Jan. 19, 1981	5.08	June 16	28.19
Jan. 20	2.54	June 30	6.60
Feb. 1	1.52	July 1	12.94
Feb. 7	.50	July 3	2.79
Feb. 10	12.19	July 4	22.10
Feb. 22	2.54	July 9	1.27
Feb. 28	.50	July 19	1.27
Mar. 4	11.43	July 28	23.87
Mar. 5	2.54	July 29	51.56
Mar. 8	13.46	July 30	14.73
Mar. 14	.25	July 31	1.02
Mar. 15	31.75	Aug. 1	11.43
Mar. 22	1.52	Aug. 7	7.11
Mar. 25	.25	Aug. 12	4.57
Mar. 26	2.54	Aug. 13	19.55
Mar. 29	7.87	Aug. 16	29.46
Apr. 11	8.13	Aug. 17	1.52
Apr. 13	2.29	Sept. 1	55.63

Date	Millimeters	Date	Millimeters
Sept. 6	3.56	May 13	12.70
Sept. 17	.76	May 16	28.70
Oct. 1	21.08	May 17	108.97
Oct. 4	47.24	May 19	13.46
Oct. 7	1.52	May 20	9.90
Oct. 8	4.06	May 24	17.52
Oct. 9	.25	May 25	1.52
Oct. 12	31.50	May 26	.25
Oct. 15	19.30	May 28	27.69
Oct. 16	88.90	May 31	15.74
Oct. 17	6.35	June 4	1.78
Oct. 26	6.60	June 11	8.89
Oct. 31	1.27	June 12	7.62
Nov. 1	16.76	June 16	7.11
Nov. 3	1.01	June 18	25.65
Nov. 4	1.52	June 19	21.59
Nov. 8	5.08	June 21	3.30
Nov. 9	3.81	June 24	14.48
Nov. 29	4.57	June 28	.54
Nov. 30	15.24		
Dec. 13	.50		
Dec. 14	2.29		
Dec. 21	1.02		
Dec. 23	1.27		
Jan. 22, 1982	.50		
Jan. 30	47.75		
Feb. 1	5.59		
Feb. 2	5.08		
Feb. 9	10.92		
Feb. 13	3.30		
Feb. 18	.50		
Mar. 6	8.12		
Mar. 14	22.86		
Mar. 27	14.99		
Mar. 28	.76		
Mar. 30	1.27		
Apr. 10	2.54		
Apr. 18	1.27		
Apr. 25	9.14		
Apr. 26	.25		
Apr. 30	14.48		
May 1	3.30		
May 3	.25		
May 5	13.72		
May 6	17.02		
May 12	176.53		

VITA

Rick Webb

Candidate for the Degree of

Master of Science

Thesis: EFFECTS OF FERTILITY PRACTICE ON CHEAT COMPETITION IN SMALL GRAINS WITH NO-TILL AND CONVENTIONAL TILLAGE SYSTEMS

Major Field: Agronomy

Biographical:

Personal Data: Born August 23, 1957, at Addis Ababa, Ethopia, Africa, the son of Billy B. and Norma Jean Webb; wife Jeannette Sue Jones-Webb.

Education: Graduated from C.E. Donart High School, Stillwater, Oklahoma, in May, 1976; received a Bachelor of Science degree in Agriculture from Oklahoma State University, Stillwater, Oklahoma, in May, 1980; completed requirements Masters of Science degree in Agronomy at Oklahoma State University, Stillwater, Oklahoma, in July 1986.

Professional Experience: Farm and ranch owner and operator, 1979 to present; teaching assistant, Oklahoma State University, September, 1980 through May 1981.

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